

Practical Teaching Reform of Electrical Control and PLC based on OBE Concept

Ruini Liu*

*College of Information Engineering, Xi'an Fanyi University, Xi'an, China
463736072@qq.com
corresponding author

Keywords: OBE Concept, Practical Teaching, Electrical Control and PLC

Abstract: According to the practical teaching requirements in the professional certification standards of engineering education, taking the experimental course of "Electrical Control and PLC" as an example, the practical teaching reform measures based on the OBE concept of ability-oriented education are put forward. These measures can strengthen the concept of student-oriented professional certification, and provide a certain reference for the improvement of practical teaching construction of electronic information majors in colleges and universities in my country.

1. Introduction

Outcome based education (OBE for short, also known as ability-oriented education, goal-oriented education or demand-oriented education), as an advanced educational concept, was proposed by Spady et al [1]. It has attracted people's attention and recognition, and has become the mainstream concept of education reform in the United States, Britain, Canada and other countries. The American Association for the Accreditation of Engineering Education (A-BET) has fully embraced the concept of OBE and implemented it throughout the engineering education accreditation standards. In June 2013, my country was accepted as a signatory member of the Washington Accord. It is of practical significance to guide the reform of engineering education with the concept of achievement-oriented education.

As an important link in the teaching of applied undergraduate colleges, practical teaching plays an important role in cultivating students' hands-on ability and analysis and problem-solving ability [2]. The traditional teaching mode, which is based on theoretical teaching and supplemented by practical teaching, has been unable to meet the needs of the society for the cultivation of applied talents. As an applied undergraduate college, it has timely discovered the shortcomings in the practical teaching link, put forward reasonable improvement measures, and further Improving the quality of practical teaching is an important subject in applied undergraduate education.

In recent years, there have been many researches on practical teaching reform, and there is a growing trend. Zheng Zhaozhao [3] designed the experimental content with students as the center, and implemented a three-dimensional teaching model of "classroom teaching + virtual simulation + experimental teaching". Zheng Chunlei et al. [4] established a new experimental teaching method that can cultivate innovative and entrepreneurial talents. Ideas. Zhang Feiyun [5] explored the

setting of open laboratory projects, and conducted open experiments in the process of project development. Li Rui [6] explored the setting of curriculum design training projects; Li Fei et al. [7] based on the OBE concept The practical teaching of electrical majors proposes reform measures, and proposes to increase the construction of experimental teaching faculty, strengthen assessment standards and increase laboratory hardware investment.

To sum up, fruitful results have been achieved in the reform of practical teaching, mainly focusing on updating the content of the project[8], reforming the teaching mode[9], strengthening the construction of the teaching staff, and adjusting the assessment methods[10]. However, most of the researches mainly focus on one aspect of the above content, which lacks systematicness; and lacks in-depth cooperation with related enterprises, which leads to the disconnection between the designed practical projects and social needs, and the trained students cannot adapt to the job well requirements. This question incorporates the three concepts of “student-centered, result-oriented and continuous improvement” in engineering education throughout the course reform. From course design to implementation and evaluation, the guidance of corporate tutors is fully considered, in order to learn what students have learned. It can be truly applied to future work, improve students' employment competitiveness, and meet the training goals of applied talents.

2. Curriculum Demand Analysis

OBE is the abbreviation of output oriented education. Its core concept is student-centered and focuses on what students can produce after education. Continuously improve educational activities, educational process and curriculum design to achieve the expected learning effect. According to the above core concept of OBE education, the key to the teaching reform of electrical control and PLC is to define the learning output of students, that is, what students can do after learning the course. Based on the graduation ability requirements of OBE engineering education certification and the skill needs of graduates' feedback after employment, the main skills to be cultivated in electrical control and PLC include:

- (1) Master the hardware wiring of Siemens S7-200 smart series PLC; And skillfully use both platform software for project programming, and be able to skillfully master bit logic editing instructions to logically control switching value signals.
- (2) Be familiar with the common sensor wiring methods, and be able to use S7-200 smart PLC to connect the analog control circuit; It can use various data processing instructions to convert and process the collected analog signal and output digital quantity, so as to realize the control of analog quantity.
- (3) Be able to use S7-200 smart PLC high-speed counter and interrupt program to realize basic motor positioning control; S7-200 smart PLC can be used for manual and automatic motion control of stepping motor and servo motor.
- (4) S7-200 smart PLC can be used for Ethernet communication; And Modbus communication with other equipment using S7-200 smart PLC.
- (5) Master the configuration method of man-machine interface touch screen; It can use the touch screen to establish a control screen to control and display the project more conveniently.

The cultivation of these skills defines the direction of teaching reform of electrical control and PLC.

3. Current Situation of Practical Teaching of "Electrical Control and PLC"

3.1 The Objective of Practical Teaching is not Clear

The practice class is only set up to meet the requirements of the syllabus, and there is no clear

"what kind of learning results we want students to achieve through experiments". Teachers only briefly describe the experimental process, but lack of in-depth explanation of the importance and significance of experiments to the learning of theoretical courses, so that students do not know why they are doing experiments.

3.2 Disconnection between Practical Content and Production Practice

There are too many confirmatory experiments in the experimental courses currently offered by the school, and relatively few comprehensive and designed experiments. Most of the practical projects are limited to simple wiring and functional verification on the experimental device, and there is no detailed explanation of the PLC hardware design method, the use of the software programming environment and other practical contents in combination with the actual engineering project. Such teaching is seriously out of touch with the reality of today's large-scale industrial automation. Students' practical ability has not been exercised, and students' ability to analyze and solve problems cannot be exercised.

3.3 The Practice Method Is Backward

The traditional "Electrical Control and PLC" course adopts the teaching mode of "theory + experiment". In the teaching method of the experimental course, the traditional experimental teaching of "Electrical Control and PLC" has the problem of disconnection between theory and experiment, the basic principle of the experiment is weak in theory, and the number of comprehensive experimental projects is limited. Judging from the current teaching effect, it is not very ideal, and the students' practical operation ability is insufficient.

3.4 The Assessment Standards are NOT Standardized

Taking Xi'an Fanyi university as an example, the syllabus of courses with practical content does not clearly stipulate the proportion of practical achievements. Therefore, the composition of the assessment scores of most courses does not include practical scores, which is also one of the reasons why students do not pay attention to practical courses. In order to stimulate students' interest in practical courses, a few teachers choose to include practical grades in the final assessment grades. However, in the experimental class with nearly 50 students, teachers often focus on guiding students to complete the experimental process and answering difficult questions. It is difficult to understand the experimental results of each student, and it is difficult to achieve true fairness and justice. score.

4. Practice Teaching Reform Measures

According to the OBE concept of engineering education professional certification, this paper reforms the practical teaching of the "Electrical Control and PLC" course from four aspects: teaching objectives, practical content, teaching methods, evaluation mechanism and continuous improvement (Figure 1).

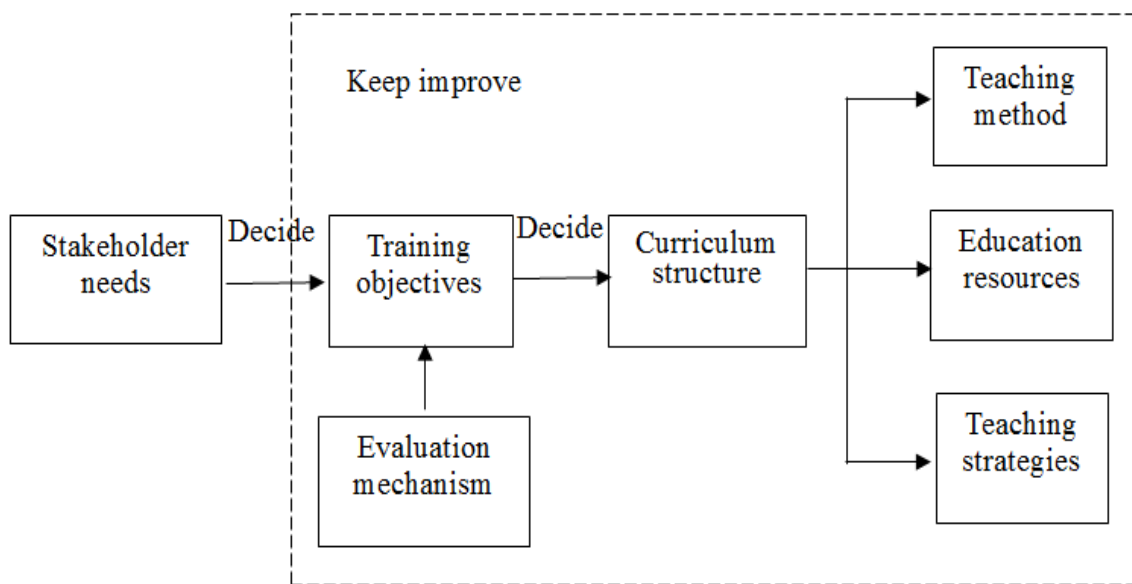


Figure 1. Logical relationship of practical teaching reform measures

4.1 Design Teaching Objectives in a Result-Oriented Manner

The end point and starting point of OBE are the final learning achievement (highest achievement). The results of research should be clearly expressed and can be measured directly or indirectly, so they often need to be transformed into performance indicators. When determining learning outcomes, full consideration should be given to the requirements and expectations of educational stakeholders, including governments, schools and employers, as well as students, teachers and parents.

Based on the idea of "reverse design, positive implementation" of engineering education professional certification, according to the requirements of enterprises for graduates, the corresponding matrix of courses and graduation requirements, and related enterprises to jointly design the teaching objectives of practical courses, in order to maximize the satisfaction of employment unit needs.

4.2 Refactoring Practice Content

The research result is a kind of ability structure, which is mainly realized through curriculum teaching. Therefore, the construction of curriculum system is particularly important for the achievement of learning results. In the curriculum architecture, there should be a clear mapping relationship between the ability structure and the curriculum content. Each ability in the ability structure should be supported by a clear curriculum content. In other words, the curriculum content should make a clear contribution to the realization of the ability structure. This mapping relationship between curriculum system and ability structure requires students to have the expected ability structure (learning results) after completing the learning of curriculum system.

Decompose the established curriculum learning objectives into multiple micro learning objectives to ensure that each micro teaching objective has a corresponding experiment, practice project or curriculum design project. At the same time, let enterprise tutors participate in formulating the content of practice projects with professional teachers to formulate the practical content in line with the actual needs.

4.3 Reform Teaching Methods and Strategies

The teaching method especially emphasizes the contents learned by students rather than taught by teachers, the output rather than input of teaching process, the research teaching mode rather than indoctrination teaching mode, and the personalized teaching rather than "carriage" teaching. Teachers need to grasp the basic and accurate learning process of each student in accordance with their aptitude.

Reform the traditional teaching methods and implement the hybrid teaching of "Online + offline". Offline: "students are the main body and teachers are the leading". Offline practical activities include two parts: in class experiment and curriculum design. The experiment part in the class is mainly explained and demonstrated by the teacher, and the students follow the operation, which is transformed into the guidance and Inspiration of the teacher. The students refer to the experimental instruction, complete the experiment independently through thinking and the guidance of the teacher, and cultivate the students' ability to analyze and solve problems. Some teachers of curriculum design assign practical topics in advance. Students complete the corresponding practical projects in groups by searching for materials, group discussion, division of labor and cooperation, and finally organize each group to display and reply to their designed control system. Judges composed of teachers and relevant teachers will score the reply. Online: give full play to the advantages of rich online teaching resources, develop and make use of online practice platforms and resources, let students make full use of their spare time for independent practice, and cultivate students' self-study ability and lifelong learning awareness.

4.4 Detailed Practice Assessment

Teaching evaluation focuses on teaching effect, rather than teaching content, teaching time, teaching methods and so on. The evaluation adopts multiple and graded evaluation standards, pays attention to the connotation of learning achievements and personal learning progress, and does not pay attention to the comparison between students. According to the degree to which each student can meet the educational requirements, grade evaluation from scratch, from small to large, from weak to strong shall be given respectively, and targeted evaluation shall be carried out.

Guided by objective assessment, adopt diversified and multi echelon evaluation standards, establish detailed assessment rules for practical courses, and quantify each component; Increase the proportion of practical achievements in the total curriculum achievements, from less than 5% to 25%; Pay attention to the process assessment, bring the performance of students in the process of practice into the scope of assessment, and establish a scientific and reasonable evaluation mechanism, so as to stimulate students' interest in learning.

4.5 Continuous Improvement

The establishment of the practical teaching management system is to continuously improve and form a closed loop of teaching, so as to achieve the best learning results. Divide the students' learning process into several stages, and then determine the learning objectives of each stage, from low to high, and finally achieve the best results. In other words, students with different learning abilities achieve the same goal at different times and in different ways.

Establishing normal evaluation and evaluation is the foundation. Each practical teaching activity should not only compare the evaluation results horizontally, but also conduct a vertical comparison of different grades. Through horizontal and vertical evaluation, establish a monitoring and feedback mechanism to optimize the curriculum system and teaching. strategy, and the final improvement effect will be reflected in the students' learning outcomes.

Through the questionnaire and big data platform, investigate the feedback of students' learning, graduates and enterprises, summarize and reflect in time, improve and perfect the problems in time, and realize continuous improvement.

5. Conclusions

For engineering majors, practical teaching is an important part of professional teaching, which can improve students' practical ability and deepen students' understanding of theoretical knowledge. This paper takes the relevant requirements for practical teaching in the general professional certification standards and the supplementary standards for electronic information professional certification as the criterion, and takes the "electrical control and PLC" course as an example. Corresponding reform measures were put forward. These measures can improve students' subjective initiative in learning professional knowledge, effectively cultivate students' practical innovation ability, and improve students' professional quality.

Based on the OBE concept, the practical teaching reform of electrical control and PLC is carried out, and the curriculum objectives, contents and teaching methods are designed based on the actual needs of society and employers, so that what students learn can be truly applied to future work, improve students' employment competitiveness and cultivate engineering application-oriented talents. At the same time, they can strengthen the concept of student-oriented professional certification, and improve practical teaching for electronic information majors in other universities. Construction provides some reference.

Acknowledgements

This work was supported by Shaanxi province education science "choices-and graver consequences-in" planning project- Teaching reform of "Electrical Control and PLC" course in private colleges and universities under the background of engineering education professional certification (SGH21Y0439) .

References

- [1] Zhou Hongfang, Zhu Zhengwei, Li Maoguo. *The Development and Innovation of Engineering Education Accreditation and Its Enlightenment to Engineering Education in my country: A Summary of the 2016 International Symposium on Engineering Education Accreditation*. *China University Teaching*, 2017(1):88- 95.
- [2] Huang Jing, Wang Wei, Qiu Xuan. *Application of Outcome Oriented Education OBE in Electrical Control and PLC Experiment Course*. *Integrated Circuit Application*, 2020, 37(12): 78-79.
- [3] Zheng Zhaozhao. *Discussion on the experimental teaching of digital circuits based on OBE model*. *Experimental Science and Technology*, 2016,14(4):184-185.
- [4] Zheng Chunlei, Yang Yongqiang, Yan Zhigang, et al. *Welding experiment teaching reform based on engineering education model*. *Electric Welding Machine*, 2018(2):130-134.
- [5] Zhang Feiyun, Shi Luhuan. *Project design of PLC open laboratory under the background of engineering education professional certification*. *Journal of Xuchang University*, 2021, 40(02):142-146.
- [6] Li Rui, Chen Jing, Wang Wei. *Exploration on the setting of electrical curriculum design training projects under the background of professional certification*. *Laboratory Science*, 2021, 24(01): 102-106.
- [7] Li Fei, Qian Jin, Zhao Qiang, etc. *The practical teaching reform of electrical majors in colleges and universities under the background of engineering education certification: Taking Jiangsu Normal University as an example*. *Journal of Jiangsu Normal University (Natural Science Edition)*, 2021,39 (01):68-70.
- [8] Yang Gang. *Design and practice of open experimental project of cutting force test based on OBE teaching mode*. *Experimental science and technology*, 2018 (3): 123-127.
- [9] Liao Jihai, Li lixiu, Zhang cunfang, et al. *Research teaching reform of electronic technology course under OBE guidance*. *Experimental science and technology*, 2017,15 (4): 72-75.
- [10] Mei Lin, Yang Lijun, sun Lingling, et al. *Teaching reform of comprehensive experiment of power system based on OBE mode*. *Experimental technology and management*, 2018 (1): 218-220.